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Good afternoon and early morning to some of you. This is the next generation engagement session for the asteroid grand challenge anniversary series. We have our participant diving and from the first -- for this point past few days. No lien, joining us from the Gold Coast Australia. Rarely -- it is a very early morning were -- for her.

We have had a fantastic couple of days are talking about the asteroid grand challenge and different aspects of engaging people and amateurs and makers. We had a science talk. We wanted to close out the anniversary with a conversation about a broader look at engagement and what we might do in some ways with education and in other ways with communication. So, to kick this off, I would like to ask everybody to take a little bit of time to share your name, your affiliation, a couple of sentences or minutes about your work and what is passionate for you. Why you do what you do. And then, the primary question, Star Trek or Star Wars. That seems to stir the crowd. I will continue down that path. I think we almost came to blows across the video last session, so, hopefully we will maintain some calm. Let me start with Daniel. If you can share with us.

If you can give me a hand on which with the crowd leaves, that would be great.

I'm Daniel. I and the digital media learning fellow in NASA's office of education. I am a research professor from Oregon State University. I have been working with NASA for a little over than a decade. My work is in education. A lot of what I do is how we can use cutting edge technology to get more interest and more students in science and technology. Particularly, the area of virtual worlds and video games are one that I work with. Digital badging. I'm particularly excited seeing the asteroid's pension, four angry birds space, later this month.

The big question, Star Trek or Star Wars?

I certainly didn't Star Trek fan longer than Star Wars. I will go with that one.

We will see where the crowd goes. Thank you. Catherine?

You for having me. My name is Catherine and the seventh-grade science teacher in Raleigh North Carolina. A little bit far away from you guys. I have been doing asteroid searching and things of that nature all the way through college. It is my passion and the education field. I am science teacher through and through. I love being able to get to something they've never seen before. Often, these young kids come up with ideas that we never think about. I'm not much older than them, but yet they still look at the different respective. This year's in the first year that I got taken by seventh graders who don't even do algebra yet. They have found 19 -- with one original discovery. That is phenomenal. I

work at a low income school, over 50% of my school is on -- reduced lunch. Most of my kids don't have computers at home in it we are still able to do this. I've been associated with NASA I guess since March when Mr. Hessler saw an interview that a local news station has been on and invited me and my students to participate in the asteroid grant challenge session that was held at NASA headquarters which was life-changing for all involved. I'm definitely a Star Wars fan and, we celebrate in my classroom, Star Wars day somewhere near me the fourth. It is the last unit of my science year.

Great. Thank you. Either you are not young and I am not too old for you to be: the Mr. Kessler.

Sorry.

Okay. Alex?

Yes, my name is Alex McDonald. I am a college with Jason with the innovation office. My response really is looking at private sector. Also, things like crowd sourcing and crowd funding. So, this is a new phenomenon and in certain ways an old phenomenon. And NASA really understands that this is an important force to getting people directly engaged in space exploration. I work here at the laboratory. It is very cool activity.

Movie?

Right. They are both credible. I always wanted to be either Indiana Jones or Han Solo. I realize the archaeological part was not white up my alley, so I figured it try to make sense --. I will say Phar scape instead.

Okay.

Thank you for getting up so early. Hello everybody. I am here in Queensland in Australia. Being involved with astronomy for 20 years now. I am part of the -- society. I have been involved with the observation campaign. Is nice to be Alex.

For 12 years now, that involves engaging the public with the -- mission. It is been a lot of fun.

I come from the area of being in a field as an astronomer. I like to share what I take pictures of in the night sky and what I learn about to the general community. I do a lot of work in school. The school library. I'm hoping getting involved in the asteroid program will be an extension of what I am already doing. So, I like to share what I know about

astronomy and space because I have been involved with it for over 20 years. Extending what I know to the general community and all of the astronomy communities here in Australia as well.

Thank you no lien. We rejoice?

It has to be Star Wars.

Thank you.

Hello. I'm from the Institute for the future. We are a nonprofit research group based in Palo Alto that studies the future in tenure segments of time. We do that for all sorts of organizations and groups and we have been around for about 46 years now. In that context, really telling future literacy is important. I started our governance future class. Looking at how we can handle bigger questions about governance and planetary questions where humans have a great responsibility. That is my area specifically. I work across all of our strategic initiatives which involves a future learning program my future work, and other areas. I mean project focus has been hoping out what we are turning the public imagination phase. How do we help people imagine and think about larger challenges that face society.

Your movie choice?

I am torn, but I would actually go Star Trek.

Great. Thank you. Finally.

Hello. I am with the digital youth network here in Chicago Illinois. I have been working in urban education reform for the last 20 years or so with a passion on building better schools for kids. And a couple years ago, I opened a school here in Chicago that was based on game design.

I joined the team last year and doing some more work in the informal learning phase and work around learning passages. How to better help kids understand what they're it are interested in and passionate about and might be talented with and how it is connected to the future of career and college.

Through that work I've been involved in a citywide initiative called Chicago city of learning where we are trying to highlight all of the informal opportunities that people have in their locality and acknowledged what they gain from their engagement. And, if through that work that I -- and NASA. The trying to figure out ways to really engage

young people, whether they know that they have passion for science or not, engage them in all of the rich learning opportunities that NASA has to offer. So, that's my connection to today.

Thank you.

And, your movie of choice?

Yes.

I broke with Star Trek on TV.

So, I would say Star Trek.

Okay.

It looks like Denise joined us. Welcome Denise.

Hello. How are you?

Rate.

We have been letting all of our participants share a little bit about themselves. The affiliation organization that they represent and then closing out with a Star Trek or Star Wars preference. So, if you wouldn't mind sharing with us?

I teach at Madisonville high school and Madisonville Texas. I teach physics and astronomy, but when I started in the astronomy program, is actually teaching middle school. And, I became involved in the program which is the -- collaboration and I was taking my middle school kids and searching for asteroids. This was in 2008. And, they were really excited. We do a little bit in seventh and eighth grade on astronomy, or science. So, we didn't have enough time in the classroom so we developed an astronomy club for the middle school students. So, it's really a good thing to get middle school kids become before school for science and astronomy. They were really excited about deciding in the program. So, our first year of searching had to estuaries. They were really excited. And, I eventually transfer that to the high school. So, when these children working in seventh and eighth grade, there are now seniors taking my astronomy class. One of the asteroid we discovered that could penetrate was catalogued. That is our claim to fame. We named an asteroid after Madisonville high.

We completed the process of finding, discovering, and naming the asteroid. It was really good for the children to see that complete process.

Round out your introduction. Your choice of movie?

I go back to lost in space. I'm sorry. That is the first sci-fi movie I really remember. I think that would be my choice.

Great. I love new answers. I think everybody can see we've got a pretty dynamic group of folks. Some shared and overlap it -- overlapping backgrounds. Some certainly different takes on it. One of the realities about the grand challenge is that it is a tender 15 your goal. I thought -- it is a 10-15 year goal. Hopefully, this will be a preforming conversation. Jump in as appropriate. We have been having questions come in through the chat window. Feel free to answer directly in the chat if you would like. To kick things off, I'm wondering about, we have seen a growing consciousness around asteroids. Your thoughts as thinkers and education and educators yourselves, how might we increase awareness and involve the awareness around these and think about it in a decade like 10 years. The future looks at 10 years time and time. Think about a grand challenge being on a large scale and a world of near-term and immediate gratification. How might we start to build a narrative around NEOs that plugs into a timeframe that most people aren't comfortable with?

I am looking for the biggest smile. Why don't I jumped with Alex. We have had some conversations along these lines and I think particularly your perspective and looking back at how things have improved and been successful. How do we model moving forward? How -- if you wouldn't mind taking a crack at this?

And hear dogs barking, my apologies. You know, I think the biggest challenge is to get a world where people understand that asteroids are a part of our future. There part in a way that they have -- a very regular basis. I think the choice is very clearly put. This happens and happens to us. Not people just with the historical past. I think we are also seeing a great deal of activity in the private sector interest for the potential resources that they have. We are seeing companies forming because they would like to --, for the water resource. Because, they see water as a critical resource for exploration for that this is a community of people, kind of the space community that we feel -- that we need to create. I think a growing awareness of that is very important. There is a critical role to play. If you think of the things like Star Wars or Star Trek, the near Earth space of asteroids, is not something they informed the public about. It wasn't necessarily something that you would have as part of steppingstone for the development of the system on this planet. I think that story is important for people to understand. It is a story that resonates in school. It resonates on TV shows and podcasts and all these types of things. It's an important story and one that we are starting to understand as the hidden story that has been missing for some time. The narrative around space exploration was the moon and Mars. These

two communities would fight it out for dominance within the space community. And over the last 20 years or so, largely with the rise of understanding of potential threats that asteroids pose to earth, this has put asteroids back on the front of our near-term destination in the solar system. That is the story that is arising and one we will benefit from in the community.

Just to let you know, because I do stick to the community, with asteroids, people are intrigued by them and perhaps a little scared by them. We call it reasonable considering their reputation with Earth. I thought if, I were to talk about asteroids a lot and give people new understanding of the object likely do with the moon. It is to give a lot of education about asteroids, about the asteroid belt. Education that there are a lot of them their. To look at it at a point of view of accepting that it is part of the solar system. There are dangers that it could hit Earth, but to just have an appreciation of what these are. They are just as important as our planets and the moon. We came across it like that, with more talk about what the asteroid belt is, is -- is.

A link to the billions of pieces of it. We can link to that. What the compositions of them are. Give more education about this particular area that is quite huge in our solar system. I think we could get people excited about them. And then we gently bring in the dangers and of course the evidence on earth as well. Community is intrigued by these things. That is where I am coming from. More education about the asteroid belt and getting more excited about what these objects are.

And asteroid belt without a giant worms and it?

Yes. That is the education side of it. Getting it across to children and adults. With astronomers that are observing the night sky, they are a bit more grown up. It would be good if the general community knew more about these.

Yes.

I was going to say I completely agree with you. It is about education. North Carolina, Joan is only taught in the six grade. Students never received it after the sixth grade. There are 11. So, if you are trying to engage the public, they will go back to their education as 11-year-olds. Most of us can't remember a thing since six great. Is really about building it in integrating it. How can we see it move on? I know in my current -- even the asteroid group they thought the asteroid rocks were just a there. They didn't even think they moved. Why would they think they moved? That was an evolving thing. If we are going to study rocks in space? As they saw how it progressed, there interest bloomed. I think it is about how you present it in finding the right time to present it and those types of avenues. I think there is a good way to get average people involved. I completely agree. You to get them young and hold onto them.

That is what I saw when I was teaching middle school. It still continues. We were lucky

to get our astronomy program in high school I watch them continue to have the same interest as they did in middle school.

I think if you catch them young, it has to progress after that. We teach it. Even in sixth grade, the Earth and science in the eighth grade. That's a little bit older, but eighth-grade, they lose a lot of it. We have keep the interest going on in the space industry throughout fiscal.

A lot of high schools don't even offer astronomy in my county.

When I moved from the middle school and high school, I started the astronomy program. They did not have it before. It is taken off.

I want to explore a little bit about this idea of a long-term narrative. So, from your experience at the Institute for the future, looking at larger timescales, do you have thoughts on how one keeps the narrative engaged? Is that something we even think about doing?

I think there are a lot of different ways you can do that. On one hand, I would love to see alternative future scenarios played out for this. One methodology that we use and a lot of future research groups do, where, it is looking at collapse, constrained, transformation, and growth. Those are for scenarios. They are extreme narratives, but they pushed your thinking out far enough. The reality is, any true development could probably be a combination of those types of scenarios. A little bit of each of them. If you can push your thinking, those are interesting narrative structures to take out into the longer timeline. How would and asteroid event be transformative? Rather than, well, class is the scenario that is more doom and gloom, but I think constraint is an interesting one. Sometimes we call it discipline Arco it becomes a narrative structure that you used to say, well, if our economy changes, how does it affect the long-term development? So, I would love to see that type of structure used to play out longer-term narratives and be able to we those together at different points. That is one tool I think would be useful. Is a really good question. It would also be interesting to plot a 100 year timeline. 10 years is a great timeline to work with but in reality, it is a pretty short timelines. -- Timeline. It is far out that the people think it is the future but it is close enough in that you sort of have parameters to work with that you understand already and no. In some ways, that is a great chunk of time to work with. It is the one we work with the most. And, it at least gets rid of turf issues. They can see results outside of just what they are doing in a database structure. It would be interesting to play out a 50 year or 100 year time scale.

That is really interesting. I'm wondering, Daniel, is that space you can go into or have you explored the work you have done in terms of a longer timescale of engagement?

It's something I had considered with colleagues. School is not a long-term proposition. Education is chopped up into little compartments. You have six and eighth-grade space

science and that is the end of it. The majority of scientist and engineers I noted a become inspired in school. Harel Sagan said he would love to be able to say he had an inspirational teacher that started them down the path but he felt he took up science in spite of the teachers, not because of them. But, it doesn't look at the timescale. If you are going to get somebody interested in something for 10 years you get them motivated to be responsible for their own learning and engagement. I have suggested the past that there are some game formats in virtual worlds. Because of their persistence, they could carry over. It still requires interest of the individual but you would have a model that could stretch with that. Now, I say that in game terms, 10 years is infinity as far as technology is. But, you could start with principles. You could use a massive online multiplayer game. People could make basis and customize it and think that it way -- appealed players and games. They can come back to it on their own time and have it scalable. You could do projects in it. And of course, my graph, which is popular now, you could hold virtually anything you want. It would have a lot of those aspects. You have to distill that interest which I think school might be a good place to start that. We've even heard after school is necessary to get strongly -- get astronomy deeply involved. We should be spending more time on it. Virtual worlds and I just read today that virtual reality is the they to become as, place as smart phones over the next 10 years.

For those not fill Marler -- for those not familiar with oculus risk, could you explain?

It's a headset. Those of us old enough to remember when Star Trek was on television, you would remember about 15 or 20 years ago there was a craze that we would have virtual reality. There was a Stephen King story called lawnmower man that was supposed to show you more about what virtual reality is. And then the 90s got here in people said, yes, virtual reality is not working. Having a headset on, having gloves the give you a sense of touch, it is too big, too clunky, too expensive and too delicate to be usable by normal people or even people who play games. So, recently in the last few years, there have been some breakthroughs in the science and engineering behind it lets you make a headset that is small enough and can be stable enough and can compensate for what a few years ago was called the Blair witch affect. The motion would -- the motion affect when your camera angle moves. You could have a headset that is lightweight.. The screen is just worn a work of art and -- is just worn far apart enough to give you a 3-D view. Is practical. I heard just yesterday from a developer that there are 80,000 of them in the hand of game developers right now. There some at NASA.

Jeff Norris has a set.

I have been meaning to get my hands on them as well.

We have them. We have been playing with them. There still work to be done.

Facebook but the company. That from Facebook is that 3-D interaction is the way in 5 to 10 years that we will be doing our social engagement online.

The demolition man has a good explanation of that one also. If you haven't seen it recently, you should. Wesley Snipes. So Vester Stallone.

Noted.

I saw you nodding when Daniel was talking about colleges that break up student as -- education. There isn't enough time in the day. Your thoughts about this, longer-term engagement or any experiences you have had that might be applicable here?

I nodded my head a couple of different times for different reasons. I do think, we found in our school that using my graph was successful with our kids in terms of building other worlds. But, I was at nodding my head when Daniel was talking because the narrative piece we are talking about is important. With many different narratives, you can create a lot of different entry points for young people to come into this story and think about their role. There's a narrative around the role that we each can play. I think this is, thinking about citizen science and how everybody can contribute to this. So, even if the problem is 10 years out, there's something you can do today that can contribute to what we know. That can be a powerful entry point for young people who we might be with just for a quarter or year. They are contributing to something larger by doing what they are doing today and how it might be used in the future and how what we know today helps us understand something moving work. When we think about -- moving forward. When we think about narratives, how do we engage people in this work and in the story. I will be honest, I and the nonscientist in the bunch here. Actually, by quest is, I'm working with someone from the clan station center.

We are going to be doing some Mars challenges the summer with kids here in Chicago. She mentioned, we are trying to land on an asteroid. What? What are you talking about. Sharing these stories that have people start asking questions. But, also helping people understand how they can contribute to answering some of those questions. Had we share the story in a way that has kids asking questions but also help them realize how they can begin to answer the questions. The other thing I am interested in, the person that doesn't see themselves as a scientist or having the skills or the ability to do that work, how do we create the entry points where they can play a role and contribute and maybe have new ideas about what they can do what science is or what NASA is doing and what that world entails.

Thank you. It is something that came up in our last major session. I'm hearing again, there is something nice about the grandness of the challenges statement. Because, there is an opportunity for people to see that it is bigger than any single agency or persons ability to work on. Looking at it in the avidity, how do we break it down into access points or ways that people can see themselves in a meaningful way and contributing. I want to throw this out there now. Do you have experiences, thoughts, examples that you have seen that have been successful in deconstructing a problem in a way that makes it

acceptable? I feel like last year of the grand challenge has been one around communication and getting the word out. This next year focuses on trying to show people the OnRamp's and how they might contribute. I would love to explore some with you all about experience in deconstructing something in a way that we can potentially compartmentalize this and make it accessible to people. Whether it is an after school program or a year-long program. I'm curious what you might have in terms of thoughts or experience on this?

Jane is a world-class game designer and she works closely with us in the Institute. She talks pretty regularly about the components that make for a game the learning. Even if the games are live, we are not talking about game design as a new product, but, she breaks them down into challenge, mastery and improvement. And then, what she calls an epic win. So, I actually think that is a useful framework to think about for all kinds of activity. You can chunk the asteroid grand challenge into smaller challenges and to see them that way even though if you don't call them that are currently. But if you see them that way and you figure out what are those mastery improvement components what you are trying to achieve and what would an epic win look like? It is addictive. It becomes a great way to teach people and be engaged, even if it is a smaller component. It is a larger challenge.

I saw a smile Daniel. Was it the epic win?

We work in relatively the same space with games and how you can tap them for other outcomes rather than just recreation. I started playing online games back when epic when really meant something. It took a long time and hardware -- and hard work. Now, it's like, I got my homework done. Epic when. Word inflation. How games can teach us to fix reality. Games work, reality is broken. The idea is, what games do well is challenge people and keep them engaged. Good games to that. There are plenty of games that do not challenge people and don't keep their interest. You will find those in the bargain bin if they ever get published. So, what good games do and it is almost magical on what makes a good game, but what they do is guide you through the early steps. They challenge you at every point. The challenge goes up when you're expert. The challenge gets better as you get a better. I use the term level, but leveling up. They move up. Their skills get better. I love the grand challenge. I love the idea of challenges. If you could find a way to make the challenges so it is not a one when order one person takes all victory. I look back when we had the astronaut glove box challenge. One person wins. What games do is find a way to let thousands of people when. If you go play Star Wars this weekend, the story is written in such a way that you feel like the central character in the story no matter how many thousands of other people applying almost identical characters. If you can take that challenge and spend your narrative so that anybody who is looking for asteroids or who is involved is winning and being a center of the story because of that, you'll get a lot for interest. Nothing against competition. I think competition inspires lots of people, but if only one person can when you will only end up with the winning team pursuing that and the others saying they were good at finding asteroids.

The other things she talks about a lot is, you really want to challenge people to do

something they want to do, not what you want them to do. I think that is something that would probably be useful for the asteroid challenge. We want people to engage in a meaningful way and help solving the grant challenge, but in reality, the way you phrase it has to be about what somebody else wants to do, not what you want them to do. I would love to hear ideas about that Arco that is a true, challenging question.

Is even more challenging if you recognize, you're not targeted about a virtual game. You not talking about something that will be easily integrated. You are talking about a multibillion-dollar effort to modify the solar system at a fundamental level. The challenge is to understand, what for example, the committed out there. One thing I love about asteroid defense is that it didn't get started in the government program. Got started because a number of people around the world wanted to do something about this. This started with the Department of Defense. So, we will get people together and care about this. The single largest meeting was the pioneer defense conference. It is a private sector event. There is a community out there. The challenge that is being illuminated by the comments here is, how to plug into that? How do you fit into the diagram of the problem-solving part? Some work with community resources and some don't. What keeps coming up in the chat comments are references to science fiction stories. The video games. You mentioned it would be great if NASA would do that. I had this all the time. My responses, it would be great if some of the private sector one of this. Actually, the private sector, you have the cave ability and resources to run the things. And may surprise you to learn, but NASA doesn't have lot of it experience or expertise running as of multi player online worlds. But NASA encourages that through particular activities. So, the challenge is really getting people who are excited about doing things like themselves and finding ways for that to --. It is something we are all trying to do.

We are already doing that. How do we record our activities and expertise?

Can I say something?

I think applications and virtual guidance are great. I think what we are trying to get here is to get people to realize that an asteroid is real and that we are trying to do something here to help our planet. I think that people need to know, when they are learning about asteroids, they are actually able to know the real object. I'm -- I am observing the night sky and seeing asteroids myself. Now, they are very small objects to see. Is not like showing the moon through the telescope Arco asteroids are much smaller and it is difficult to show the public these things. But, I think getting too far away -- I love applications, and I think that is a excellent way to teach people. But I would like to see people know that they are talking about real asteroids. Educating people on what they are. I would be going down the line through my education of doing exactly that. Also, being involved with a lot of astronomers. That would be real science. Observing the night sky and observing these asteroids. And linking up. Somebody could produce a broad -- program that we can all link into and we could all have eyes on it. This could be a real challenge. One of us could discover an asteroid that is out there. Coming from that field. You think people to realize that an asteroid is a real object out there in our solar system

and can be a real threat. That takes people out into the virtual world. I would be talking about the children and community about the real asteroids. That is probably what I wanted to say there. It is good. Virtual games are good. But the asteroid challenge is what the challenge is about. Protect our lands from potential asteroids. Educate people on the real objects out there in the night sky.

We should put a meteorite in every classroom.

Excellent. Where they could feel it and know that this is a real object.

I will take ones that show them they could be in all bits -- shapes and sizes. Get a feel that this is really a real thing. That is where I am coming from.

Maybe we can get the last panel that was talking about 3-D printers to have a massive effort of three pretty asteroids so we can at least get a model in every classroom.

Let's get meteorites and send them across the world.

Great imagination. A lot of educators here. These children, they are already thinking about how they can --. They have all of these great ideas. The challenge made it worldwide. Yet different age groups or classes and get those ideas out there. It the children to do their drawings and pick up ideas on how they are going to get rid of these asteroids. They are really smart, these kids, as you know. So, the challenge can be for everybody. Make it different for different people. There is a lot of excitement there to get interest in that. You know, what the challenges about.

A good example is Russia and the asteroid that came across Russia attempted that damage. All of the cameras in the vehicles that cost -- Cox that camera -- all of the cameras in the vehicles that caught that, I showed it in class. Is actually lying to the sky. I have one that has been sliced. You can see the first elicitation of metal. It is different than the rocks we have here on the Earth.

We just have to get them interested.

That is what I would say. Made it real. It shows kids that there is so much that we don't know out there. I think sometimes showing them the pictures helps a lot to make it obtainable. Just like searching and finding them made it real to them.

You had success in the classroom. We are talking about being able to make this tangible, meaningful, for the students. Because, I think it was a great point that we can't define this in our own terms. We need to make it a conversation where other people are interested and participating. Can you explore a little bit what has worked or what hasn't worked from your own experience?

Definitely. I will say that when I first pitched this to my school it was turned down, even though it costs no money. I did on my own time because education -- and other areas. As they pushed and pushed and pushed, we got support. We still struggle with a lot of support. Education is always in that battle, but with my kids, we are constantly doing updates on our school website. We found another one and I had teachers e-mailing me. Our local news station did a story on it. I had teachers from everywhere, contact with how we did this and how we replicated. That is what we need. We have one start a light -- we have one satellite campus as an example and we have it to brocaded. With every asteroid we found, we got a star that we put on our teachers. That was something simple. It was little. It was awesome the. My kids where -- Mike is where their NASA pens. It made it community. I was the NASA teacher. I got the reputation. I could talk about asteroids and start the conversation. Sunday has to be the any pick and say that I will take it and try it. We had the names on the back and we had people sign up. We where these around school and events. We are known as the asteroid team. That could be easily replicated.

When it started out the middle school, you had to be a teacher that wanted to start the program. I had no problem getting it into the high school. Those of the things we did with the kids and how interested they were in doing that science. If you're not familiar with that, how it works is they tell us to take pictures of the night sky over a period of time and they send those images to the schools within 24 to 48 hours. We get those images for the school and we analyze them. Kids know what the sky looks like. It is black with white dots. They can relate to where it is and what is going on. But then when they see the stars aren't moving, that is an asteroid. That is something they can see and rate and find. It is like again, where's Waldo. There it is. I found it. They got the reward and searching. They get excited about looking and seeing and finding and doing that. Like I said, if they started this in middle school, follow me up there. It worked out so well that kids took it in middle school and took it in high school. I have one girl who graduated last year who is now mechanical engineer with a minor in physics. Is that right? She has continued and I hope that maybe it was the asteroid that she found in middle school. Hopefully, that will be the latest. They search for the asteroids and getting those kids and their. It begins with the teacher going after it and learning how to do it and bring it back into the classroom. Teachers don't have a lot of time so they have to be able to get something in their hands that they could take into the classroom with not much time to learn how to do it. You mentioned 3-D printing. The reason I was late getting in here is because I'm taking a workshop and we got assigned professors to do research. Research I was assigned to was a professor that wants to put 3-D printing into schools. So we are right now working with 3-D printers. We are the test group. They want to get it into the schools so kids can get engaged in science. Right now, they are targeting seven and eighth graders will then take it back to the school and teach fourth and with Raiders how to use it. That will then perpetuate and keep it going. When those get the seventh and eighth graders, they can take the technology and move on with it. But again, it starts with those teachers taking the time to do and learn how to work these programs and bring them into the schools. We see the kids, we see children were then their parents see them. They are at school all day. The teachers are with them. They are sleeping for eight hours of the time with their parents.

We get them for eight hours a day away. We have a lot more influence on what the kids learn and see and do that a lot of times their parents do. For me, it starts with the teacher. Getting the teacher involved and getting them back into the classroom.

We need to target teacher education programs. Part of the reason why I felt confident with this is because I did this in college. I did this at my college. I had experience with it. I was familiar with it. So as a teacher, it wasn't starting something brand-new. I'm fairly new teacher. I didn't have time to learn something, but I use my alleged experience in the context tell me. I also had an advising professor that I could shoot e-mails to say, how do I do this? So, I was able to practice in college and model it in college. When I went to the classroom it wasn't as scary. We need to hit our teacher education programs. Give these teachers the ability to train and practice with it so when they walk into a classroom they know how to do it. It also a huge marketing skill. As a first-year teacher walking in, this can actually do something to 20% your skills? What -- will say no to the teacher? Is one for the college. It is a win for the students and a win for NASA. Getting these people interested. Like I said, as a younger teacher, you are looking for the that thing to get the edge. Teacher education is where we need to go.

I teach in a rural areas we don't have a lot of outside community resources to bring into the classroom physically. A lot of the stuff has to be done through the Internet. Virtual, like are doing here. We don't have the funds to travel long distance multiple times. We have to bring it in. Either on the Internet are just hands on?

Resources, again. Internet. Since we can do our program totally over the Internet, that is what made it successful also.

I completely agree.

We say that a similar experience that you have had an the city of learning? Connected to the teacher to enable the ability to frame is something so the students can take it as their own?

Not yet, only because we have been working so hard and the out of school space. We are just beginning to develop these relationships with teachers and formally in school. So, not as much, although, one thing we are trying to do is find as many books? Find as many entry points as a can't for kids to do things they are interested in. And, so, kind of going back to the earlier conversation, I think that making these things real for kids can be a big hug as well as, sometimes it is the a new birds gave that is the hook, but it is always what comes after that that continues to gain interest and give kids questions about where they can go next to pursue the questions. I think we are only just beginning to learn how to make connections and engaged students. But, I think we need to be looking kids outside of the classroom and see what happens inside school and also looking kids inside school but knowing where they can go outside of school to continue that learning and that engagement.

We also have clubs and organizations participating. With all different kinds of outside organizations that also participate. You can get the kids engaged in multiple things.

Whether, not only in school, but also on the -- organization.

I think you need as many on ramps as possible. One of the things is, how you get students to see themselves as a sort of people who want*Ã…rhus go -- want asteroids or go into science. For some it is a book or game or movie. It is bridging the gap because as long as you don't think is something you can do you will never start down that path. The outside, the things you just said about the outside groups. I worked some with 4-H year the DC area. They do, like what we said earlier, they do go beyond regular curriculum segments and raking up the day or just one year. You complete years into that. That does help, but eventually, and again this is -- eventually you have to turn those kids and what we are now calling lifelong learners. People who know how to engage their own learning. If you don't inspire them about asteroids or science or engineering in the bigger picture, that they're not going to go down that path. Any can't inspire them and give them the tools whether it is games whether it is in the classroom or whether it is staging a course online, you have to give them tools to say that they can do these things. They want to do these things and they want to learn more about it, otherwise you end up like my cousin who is proud of the fact that he has not read a book since the end of high school.

Exactly. But can't is the one thing. It might be books. MIB Internet. It might be virtual games. Every kid is not going to be a game player. It will not all be readers. So, there has to be multiple access points like you say.

Hunting asteroids is a great thing because, the Internet is a key. You can have it linked through a game. I know there's the angry birds astroid expansion and there's a redirect mission. Both of those games should have an easy-to-follow link that they could back to the coheres how you can discover real threats to planets. Every science feature in the con -- country should have a quick, easy way to point and say, here you go. This was fun in school and now you can do more. Boy Scouts, Girl Scouts, every organization.

What to get them started, they will hopefully go on answer to their own things that they need to do. Now, we started this in 2008, computers and classroom or something new. We had them for the teachers but we didn't have access for the children except maybe a few and the library. So our computer access is limited so if you could do anything then on the computer, they were for it. They wanted to get on it. They wanted to do the searching. They wanted to do that stuff. Now, these kids born with computers, and started in kindergarten with computers and that is what they do the stuff with, it's almost become like a telephone. I don't know if it has peaked and we are coming down but like I said, to reach our rural areas we must have Internet.

On the flipside you have have the technology that is able to run these programs. The

program we used is not compatible with our school programs. I have to bring my personal laptop to school for all of my kids to sit there and punch on it. That is because it is my engagement. Our computers, we make the joke that the computer me and but the program may not load. Is a joke. You can't rely on technology at all. So, I think it is time for facilities to upgrade technology so we can do these. For a lot of us, as a problem. My kids can't -- without the laptop.

I think that is a specific area problem. Now, we have a firewall on YouTube and things like that, but we did get fiber optic Internet in the last few years, so that helps a lot and helped our problems there. We have been working with schools where, they only had a cycle of electricity every four hours. They had four hours that they could be Internet search for asteroids and then they were off. So, it happens in a lot of places where, the technology and stuff is still not there. They try to work around it as best they can. But again, to get the outside world into these areas takes the Internet.

This conversation was born in the the around asteroids. Other examples that people can point to a side of the asteroid world where educational programs -- well, I heard teachers need materials and they need access to information. Are there models that people have seen that we can build upon or maybe not have to reinvent the wheel in terms of networks when each grade that already exist with people?

I can speak for Texas. We are problem called -- which is Texas regional collaborative that is based out of Austin Texas. Within that region, there's a collaborative. There's a director. And the teachers in that region are invited to come and do science workshops that help you in the classroom. So, it was a great help for me when I was a new teacher in 2004. Getting with this collaborative and other teachers. Being able to fuel off of their ideas was wonderful. So, that is something already in place here in Texas. Like someone else was talking about, getting and organization or network where people can key in and get their ideas and help and --. I did this, is there anybody that can help me with this? It is really a good thing. I guess that in Texas, it is the -- that I utilize.

North Carolina has a -- Institute which is one of the largest companies and it creates funds that will do funding for specific schools. It allows teachers to do technology training where people will learn different stuff. It funded a middle school girl science camp we can go. It is a huge company in this area. Is well-known all over. I'm from -- County public schools. Duke University helps a lot.

Alex, any examples from your world that are applicable here that you can think of?

What's left?

[Indiscernible - low volume]

You can go ahead. I'm thinking, most of our work is not related directly with schools. I'm thinking about some of the networks outside. The -- community, which you probably talked about it earlier sessions. And then, things like -- that are doing a lot of work. I think those communities are pretty easy to reach. I'm still pondering what other ones would be useful.

Universities in the area are also useful. Texas A&M, or I live, they have a lot of summer programs that help with teachers. One that you all might be interested in is --. As a teacher organization that would get teachers together. We went to JPL when we were with a group.

The B6-12 foundation was one of the first. They serve the purpose, but the focus now on actually resolving technical challenges of having a very large piece to discover*. The lead is being taken by a private sector organization. Whether they raise the funds for that is an open question, but it is a Silicon Valley-based group. Their connection to a number of experts. They rely on a prime contractor. There is no reason to expect the they are having less the potential success. But, one of the things that it has left a void for is a membership organization. Those that are working on asteroid defense. You ask the question of, what are the models for communities that share these ideas? I'm struck by the dual track of this conversation which is education in school and outside of schools. There were comments that there was a projects of fan fiction.

There are a number of these communities. Nonprofit membership-based organizations have a long history of developing solutions and dividing the shared interest of the group and organizing around that. The Birmingham lunar society. Noise had to get that in. I think there is a huge space for that. This is different than a membership organization. That is something not there now and there is certainly space for that if people are willing an organized.

I would like to reach out. Your experience. Alex help break out the dual themes that I have been hearing but in school education. Not only just after school, but communication to a general public. Do you have examples of your own experience of this being successful? This external community engagement?

First of all, in the schools, we are a lot smaller number of people than you are in the United States. I get contacted by schoolteachers for resources. It's not only your own people in America that uses the resources. People around the world as well. Every time I am contacted by a teacher, I forward them to your websites. Avenue -- afterschool programs, I started off with astronomy programs at schools. Teachers teach about astronomy. As with getting them interested in whatever I decided to talk about, I use a lot of your information. My involvement with the -- mission, that is being so successful here in Australia. Not only do I talk about the mission with outreach programs that they community of schools and everything are in, the resources on the webpage for us members, and I think there are about 400 of them are over a 12 year period. They gave us to get to the general community stays with the public and schools starting from preschool

right up to 85-year-olds. It is very successful. So, that is with JPL. I can only speak for that particular program just giving educators some resources. I know you're going away from that sort of thing. But it has been extremely helpful and it helps the public know all about what you are trying to talk about. All I know is that everybody is interested in space. When you give the correct information, they go home they start to think about it and next thing you know they are into it and want to be part of it and want to continue JPL has a wonderful program. That is all I can so -- I can say in that respect.

Unfortunately, we are almost amount of time -- almost out of time. In order to give everybody a chance, I would like to cycle through and let everybody have an opportunity to make some closing remarks the whether they heard something interesting or spark new ideas. I also hope that this is not the end. We have a wiki going and new relationships starting. I see a lot of checkbox action and I appreciate buddy turning in to participate. So, let me start with Alex at the bottom.

What do you want me to start on?

I would love you to start on the last 1.5 hours and how it has been all over the place. What are your thoughts on how we take this forward an and -- forward and ideas how we can build on this?

The enthusiasm for the role that narratives play in shaping this. The reality is, the 19th century spaceflight began as an intellectual expert of people that wanted to write about the. About it. They wrote stories that had an influence, literally, for 100 years. People will reference Leonard Rozelle's work. I would certainly encourage all of us to think about whether or not we can create some of those narratives ourselves. We can tell them. We don't need initiatives. We can start to articulate them and tell them amongst our own communities. I think that is some of the court tasks we have in front of us. Particularly narratives that are hopeful about our ability as a society and planetary community to use the resources of the solar system to ensure our capability to survive and our capability to have filling lives. I think that's a core part of all this. People recommend important of asteroids and that is 19th century.

Resources of the asteroids that provided feeds.for many human society. That is still true today. Telling that story in addition to the --, that is a critical method.

Great. Thank you.

Any closing thoughts?

I can say, whatever you do, you get them interested in anything. Science, asteroids, space. Whatever you can, get them going. Get them out and away from the videogames if you have to. Or, as fire them for some good ones.

Thank you. I would echo what Alex said about the importance of story and narrative. Again, the importance of buying multiple entry points for kids. I wanted, people argued know about the site, but -- is another resource for a place where there is is curated stuff presented in ways that could spark interest across the broad range of youth and adults.

Tina?

I was thinking a lot about, there are a lot of people think about this intersection of science makes science fiction and how that plays out. I think there's something relevant about that for use in particular. However you want to define the next generation. I think storytelling and narrative way a large role. So, because asteroids is a great story to tell, we should be doing that in a way that pushes people toward real science and have access points for them that meet them where they are. Not entirely sure what that means for you guys, but think there are a lot of lessons that we learned from groups that are not necessarily in -- role. Even things like the Harry Potter alliance that are done an amazing job of getting young people motivated toward action and responsibility in the real world based on different fantasy plots. Not just Harry Potter, but they had a campaign about Superman and immigrants. That was an exciting and creative thing Hurco I will think about it more, but this role of science and science fiction --.

Great.

Thank you for inviting me to be part of this today.'s lovely. Yes, also coming from the area of being a proper observing astronomer, -- I listen to everybody talking about how you can excite the students. How you can excite them about asteroids. I think that is wonderful. I think adults are just excited about these particular objects. With the challenge, I think it is wonderful to get out there and let the general community know about how wonderful these objects are. You have more education about them. Getting them in the science field. Getting a lot more history about what they are and how important they are. It would help the imagination of the general community as well as the children. I'm coming from that area. I'm looking forward to being part of this. Thank you very much.

Catherine?

In summary, as a teacher I think kids are the --. I think teacher education, going back to universities, what they will do for one day with the kids. Also opening up doors like NASA has, allowing them to do. That opens doors even for the parents to give them a new appreciation for space. I think having groups have the ability to come and even talk to you. Holding sessions like this could be incredible. The idea of doing something more than themselves. How can we sell space back? Everybody watches rocket launches from the television. How can we get space back? Our parents grew up watching people land on the moon. How do we get that excitement back because, when we find that, I think that is

what will sell our. Thank you -- our program. Thank you.

It may be I say this because I am working at NASA headquarters. They say there is no budget funding for this or that. NASA needs to not try to do something on its own. NASA doesn't have expertise in game development. I suggested a asset-based, massive will the player on the game and put out a solicitation for. I know that better than everybody. But, there are brilliant examples to put out the expansion for the game. Work with people good at doing things and know how to do it. Like our enthusiastic teachers here, I bet you aren't pay more than 20 or $30,000 a year for them.

The chance to be affiliated with NASA and have them respond to you, be interested is important. I think working with NASA and for NASA, we forget about that. So, that is important. What you have with asteroids is a chance for people to really do something. Not a fake citizen involvement where you put a questions and people answer them and you think, for them in the trash because they didn't care anyway. But real opportunity to be engaged. All too often, what NASA does is broadcast rather than interact. This is a brilliant opportunity to interact and get engaged. Nothing will teach somebody. And whether it is a child or adult where they are the sort of person that could hunt asteroids like really hunting asteroids. You can get a much better case here than say, I don't know, somebody studies the core of planets someplace. You have an opportunity and you should take advantage of it. Citizen science is a great way to do. Okay?

Thank you for that close out. Thank you to everybody who participated, both as speakers and those who A very active Going. When I reflect on the last two days, the really great transition is there. As we look to start to move and to engage folks, I again ask if this is not the end but just the beginning of this continued conversation. So, thank you to all of those that have participated and a special thanks to SSERVI and her crew here . We have had a fantastic job supporting.

I thought question. I will close by saying, may the force be with you.

Thank you very much.

Goodbye.

[Event Concluded]